with facts. Mr. Donovan terminated this part of the inquiry with the following observations:

"I have thus freely expressed my opinions relative to the current, fearing that the old legitimate sense has been lost sight of; that many have understood it to mean something more than is warranted by *proved* properties; and that the universally admitted identity of the agent in electric and voltaic phenomena has emboldened philosophers to attribute qualities to the former which belong only to the latter. On the whole, I conceive that the current, in its modern acceptation, instead of explaining voltaic phenomena, is calculated to mislead; and that it is of no avail in obviating the difficulties which beset the alleged simultaneous operations of the two states of electricity, when present in a state of commixture, and which, instead of being at that moment in their condition of greatest energy, should be destitute of all sensible properties."

Sir Robert Kane read a communication from the Rev. Dr. Callan, Professor of Natural Philosophy in the College at Maynooth, on some improvements in the construction and use of the Galvanic Battery.

"Some time ago, whilst I was reflecting on the principle of action of Grove's and Bunsen's batteries, it occurred to me that lead might be substituted for the platina of Grove's and the carbon of Bunsen's. I put into the porous cell of a Grove's battery a plate of lead about one-sixteenth of an inch thick, two inches broad, and six inches long. I found that the voltaic current produced by the lead, excited by a mixture of concentrated nitric and sulphuric acid, was very powerful. I afterwards compared the power of the leaden battery with that of a Grove's battery of the same size, by sending at the same time, but in opposite directions, through the helix of a galvanometer, the current produced by the two batteries. Both batteries were charged with the same acids. The voltaic cur-

rent from the platina battery destroyed the deflection of the needle produced by the current from the leaden one, and caused an opposite deflection, which indicated that the former current was nearly twice as strong as the latter. The two batteries were allowed to work for three hours and a half. At the end of that time the current from the lead was more than twice as strong as the current from the platina. The quantity of lead dissolved during these three hours and a half was very small.

" It struck me that, by diminishing the action of the acids on the lead, I might increase the power of the battery. I therefore covered a plate of lead with gold-leaf, and coated another of the same size with chloride of gold, in the same way in which sheet silver is platinized for Smee's battery. These two, and a platina plate of the same size, were put successively into a porous cell of a Grove's battery, and the voltaic current was sent through the helix of our large electro-magnet, in which the iron bar is about thirteen feet long, and two and a half inches thick, the copper wire is about 500 feet long, and one-sixth of an inch in diameter. The magnetic power given to the electro-magnet by the leaden plate coated with chloride of gold, appeared to be fully equal to that produced by the platina plate : the magnetic effect of the current from the leaden plate covered with gold-leaf was not so great. Platinized lead produced as strong a current as platina, or as lead coated with chloride of gold.

" On last Friday week, a leaden and platina battery of equal size were left working for four hours and a half. At the end of that time the plate of lead acted fully as well as the platina plate. When the nitric acid was so much exhausted that the lead was barely capable of magnetizing the large electro-magnet, so as to sustain a certain weight, the leaden plate was taken out of the porous cell, and a platina plate of the same size put in its place. The platina plate was not able to make the electro-magnet sustain the weight which the lead caused it to sustain.

" When a zinc plate is put into the porous cell, and a leaden one coated with gold powder is placed on each side of it, in the exterior cell, the effect of the voltaic current on the electro-magnet appears to be greater than that which is produced by a single platina and double zinc. The voltaic current from a leaden or platina battery is about fifteen times as great as that of a Wollaston battery of the same size. In all the experiments which I have described, the lead and platina plates were about two inches by six. The lead and platina were excited by a mixture of concentrated nitric and sulphuric acid, and the zinc by diluted sulphuric acid. The acids employed in some of the experiments had been previously used.

" When a platinized or gilded leaden plate is taken out of the cell, and afterwards immersed in the acid, it does not produce its full effect until it has acted for about a minute. The lead plate, after being used for a long time, requires to be again coated with platina or gold powder.

" Seeing that the concentrated acids, by dissolving a small quantity of the lead, gradually removed the powder of gold or of platina, and that the nitric acid was very expensive, I endeavoured to find a cheap substitute for it, which would not act on the lead. The first that occurred to me was common nitre. I dissolved about the eighth of an ounce of it in sulphuric acid, which I diluted with about an equal bulk of water. I poured the mixture into a porous cell of a Grove's battery ; after putting into the cell a platina plate, I sent the current from the battery through the helix of the large electro-magnet. The magnetic power given to the electro-magnet appeared to be about equal to that which the same battery produced when the platina was excited by a mixture of equal parts of concentrated nitric and sulphuric acid. The platina plate was taken out of the cell, and a platinized leaden one of the same size put in its stead. The magnetic power given to the electro-magnet by this battery was greater than that which was given to it by the platina battery when the platina was excited either by the

concentrated acids, or by the solution of nitre. The battery was kept working for nearly an hour. During that time there was very little diminution of its power, and apparently no action on the lead or platina powder.

" I afterwards tried the power of the leaden battery when the lead was excited first by the nitre dissolved in water without acid, and then by the diluted sulphuric acid without nitre. The voltaic current was feeble in both cases. When a few crystals of nitre were put into the cell containing the diluted sulphuric acid, the power of the battery increased as the nitre was dissolved. The power, then, must be ascribed to both: to the nitre and sulphuric acid.

" I have compared the power of platinized or gilded lead, excited by dilute sulphuric acid, with that of platinized silver, and have found the former fully equal to, and as constant as the latter.

" From the experiments which have been described, I infer, first, that a battery equal in power to that of Professor Grove may be made by exciting platina with a solution of nitre in dilute sulphuric acid, or by exciting gilded or platinized lead with concentrated nitro-sulphuric acid, or with common nitre dissolved in sulphuric acid diluted with about an equal bulk of water; secondly, that platinized or gilded lead may be substituted for platinized silver in Smee's battery.

" The advantages of what I may call the nitre platina battery over Professor Grove's nitric acid battery, are, first, that the expense of the nitre necessary for working the former for a given time, is only about the thirtieth part of the cost of the nitric acid required to work the latter: the diminution of expense in working the voltaic battery will contribute very much to make electro-magnetism a more economical prime mover than steam; secondly, that from the nitre battery there are no noxious or disagreeable fumes.

" The advantages of the nitre leaden battery over Professor Grove's platina battery, are, first, that the former is

very cheap compared with the latter: a plate of platinized or gilded lead, one foot square, may be made for a shilling, but a platina plate of the same size will cost nearly three pounds; secondly, the expense of working the former for any time is much less than the expense of working the latter for the same time; thirdly, the nitre leaden battery does not emit fumes of nitrous gas.

"The leaden battery, when charged with nitro-sulphuric acid, appears not to exhaust the nitric acid so rapidly as the platina battery; probably, a good deal of the hydrogen, which would otherwise unite with the oxygen of the nitric acid, is dissipated by the gold or platina powder on the surface of the lead.

"The advantage of the platinized or gilded leaden battery over Smee's battery, is, that platinized or gilded lead costs far less than platinized silver. A plate of the former, six inches square, will not cost more than three-pence, whilst a plate of the latter of the same size, will cost about three shillings.

"I shall now mention a few more experiments which I have made with the leaden and platina batteries. I compared their power in magnetizing our large electro-magnet, and in producing heat. The magnetic power and heat produced by the platina, excited by concentrated nitric and sulphuric acid, was equal to that produced by the platinized lead excited by a mixture of nitre and sulphuric acid diluted with an equal bulk of water. Each of the batteries fused the thinner of the two wires which I enclose. In each battery there was but a single voltaic circle. The platina and leaden plates contained each about ten square inches; they were about five inches long and two broad. Neither of these batteries was able to fuse the thick wire; but when about a tea-spoonful of nitric acid was poured into the cell containing the leaden plate, and the current sent through the thick wire, it was fused. The platina battery only raised the thick wire to a white heat. Hence, I infer that platinized lead, excited by a mixture of

dilute nitro-sulphuric acid and nitre, produces a more powerful voltaic current than platina does when excited by nitric and sulphuric acid. In consequence of the small quantity of acid contained in the lead cell, its power declined sooner than that of the platina. From the results of several experiments made with the platina and lead batteries, I have come to the conclusion that the expense of doing a given amount of work by the former, excited by nitric and sulphuric acid, would be about three times as great as if the work were done by the latter, excited by a mixture of nitre and sulphuric acid. I have tried a mixture containing one part of sulphuric acid and three parts of water, in which a little sulphate of soda and nitre was dissolved. When the platinized lead was excited by this mixture, the power of the battery was very great, but not so great as when the mixture contained as much sulphuric acid as water. I have not as yet tried any other sulphate as a substitute for the sulphuric acid. When the platinized or gilded lead is taken out of the cell, it should be rinsed in water, and dipped into a weak solution of chloride of gold or platina. By this means, and by amalgamating the lead plates with mercury, before they are gilded or platinized, the platina or gold powder may be kept on them for a long time.

"The reason why the platinized or gilded lead produces so powerful a voltaic current is, that the acting metals are not lead and zinc, but platina or gold powder and zinc. It appears to me that the current produced by zinc and platina, or gold powder, is more powerful than that which is produced by zinc and platina, or gold. Perhaps by depositing on lead a powder of some of the metals, such as tungsten, arsenic, &c., which are more negative, compared with zinc, than platina or gold is, a battery may be yet made which will be more powerful than the platina or platinized lead battery. I have tried antimony, but it did not answer."